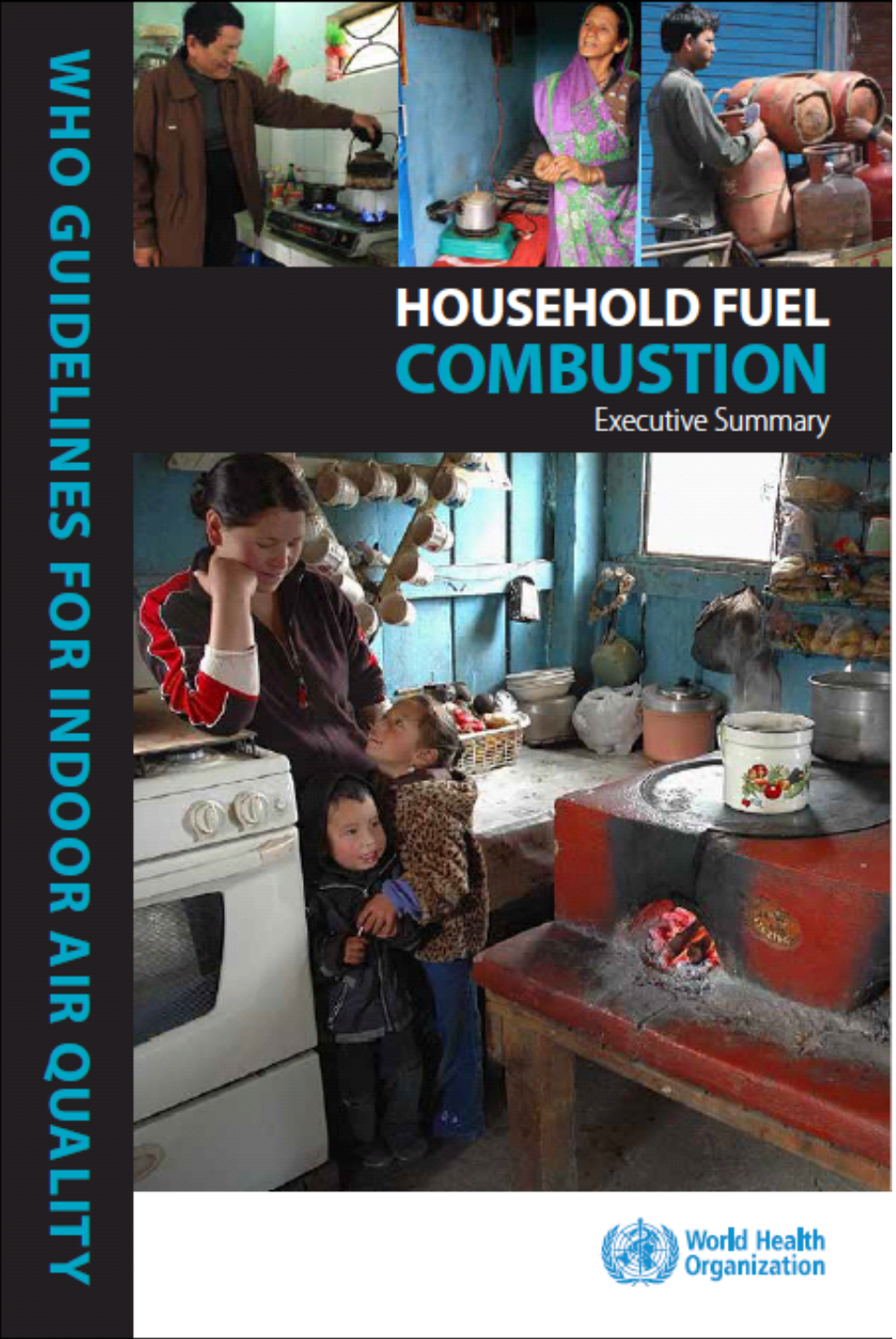

Overview of WHO guidelines for indoor air quality: household fuel combustion

Dr. Carlos Dora
World Health Organization

World Health Organization

Overview of presentation

- Household air pollution related deaths
- New WHO guidelines for household energy technologies and fuel emissions
  - Scope and key questions for the new Guidelines
  - Connection with existing WHO air quality guidelines
  - Main areas of evidence reviewed
  - Recommendations
- Implementation & next steps

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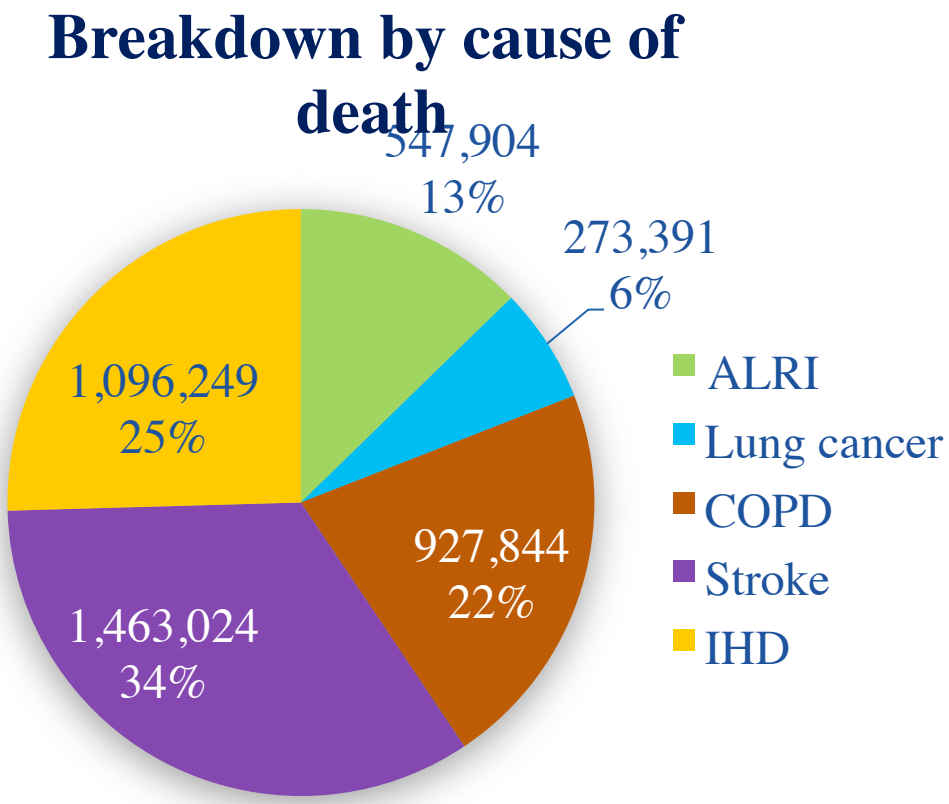
4,3 m deaths were due to HAP in 2012



~54% of **all** pneumonia deaths among children < 5 yr

~30 % of **all** chronic COPD deaths

~22% of **all** stroke deaths

~17% of **all** lung cancer deaths

~15% of **all** deaths from ischaemic heart disease (IHD)

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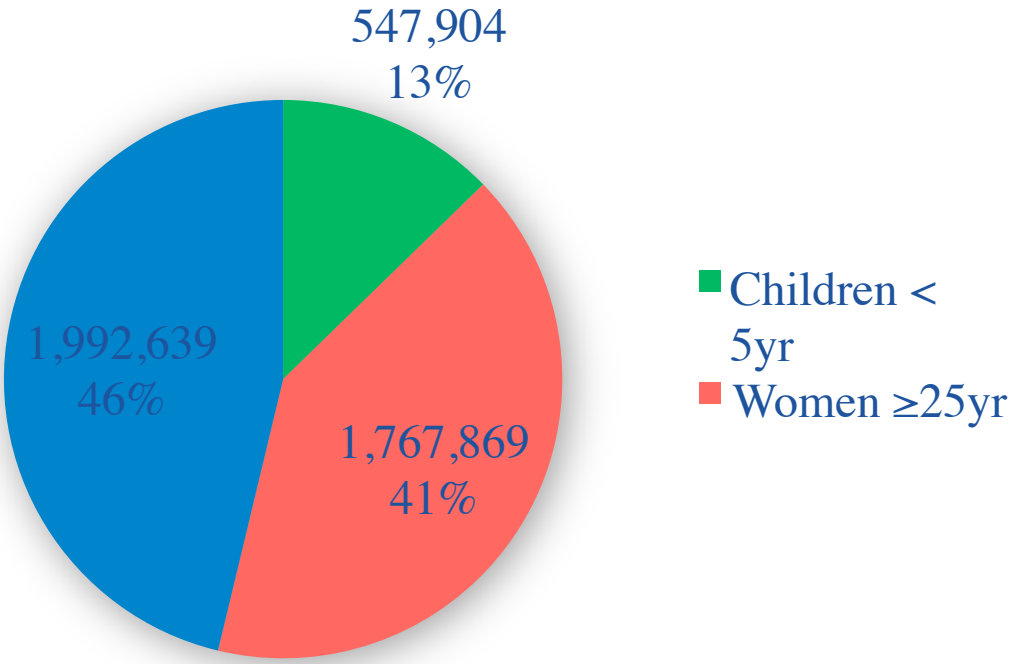
HAP Mortality, 2012



- More than 50% of all HAP attributable deaths in women & children
- Disease risk from HAP is higher in women than in men, but underlying disease rates are higher in men

Disease	RR (95% CI) women	RR (95% CI) men
ALRI	2.9 (2.0-3.8) for children	
COPD	2.3 (1.7- 3.1)	1.9 (1.2- 3.1)
Lung cancer	2.3 (1.5-2.8)	1.9 (1.4-2.3)
IHD	(1.4-2.2)	(1.4-2.2)
Stroke	(1.4-2.4)	(1.3-2.4)

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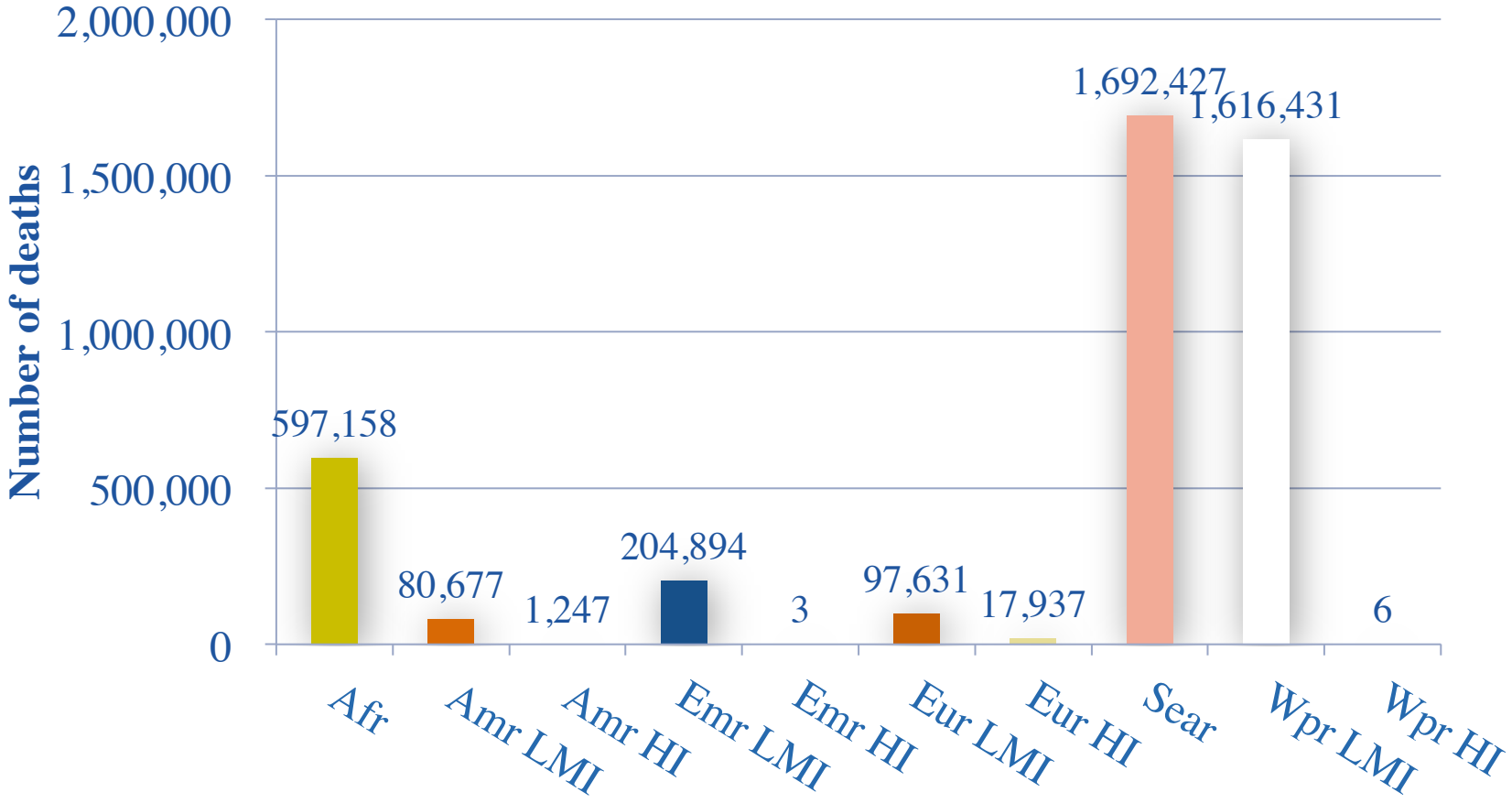
Number of deaths by HAP, 2012



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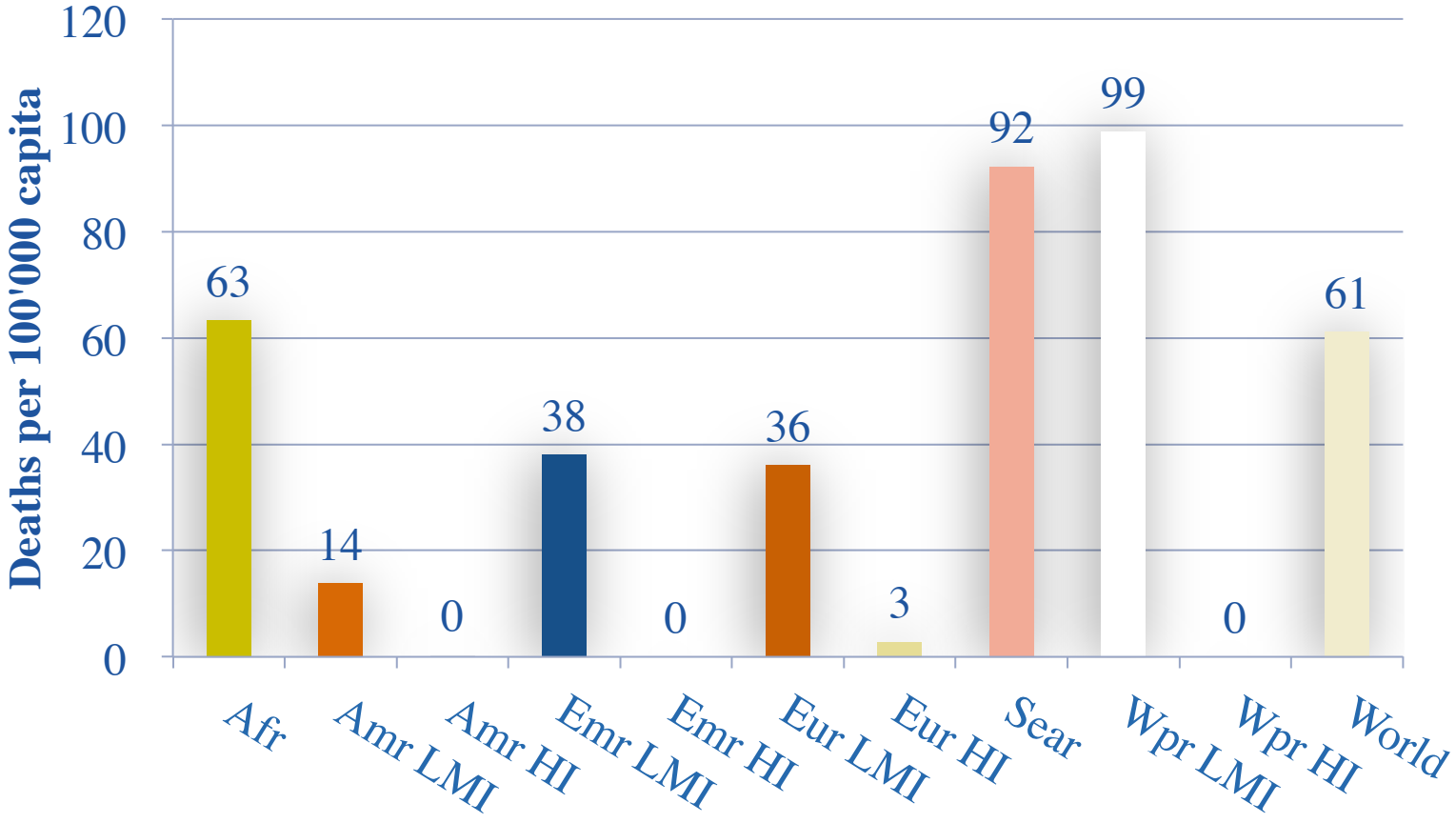
Deaths per capita HAP, 2012



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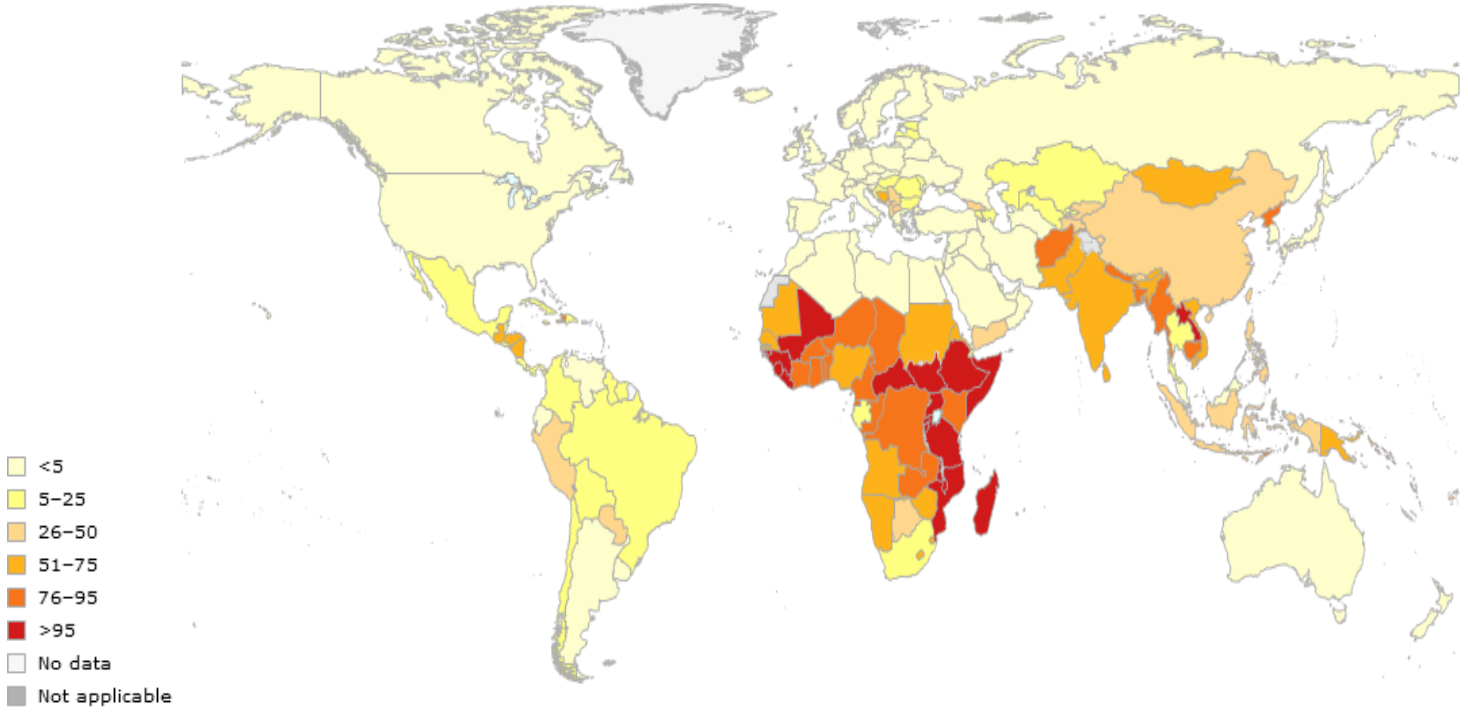
HAP Exposure, 2012



Population Primarily Relying on Solid fuels for cooking in 2012

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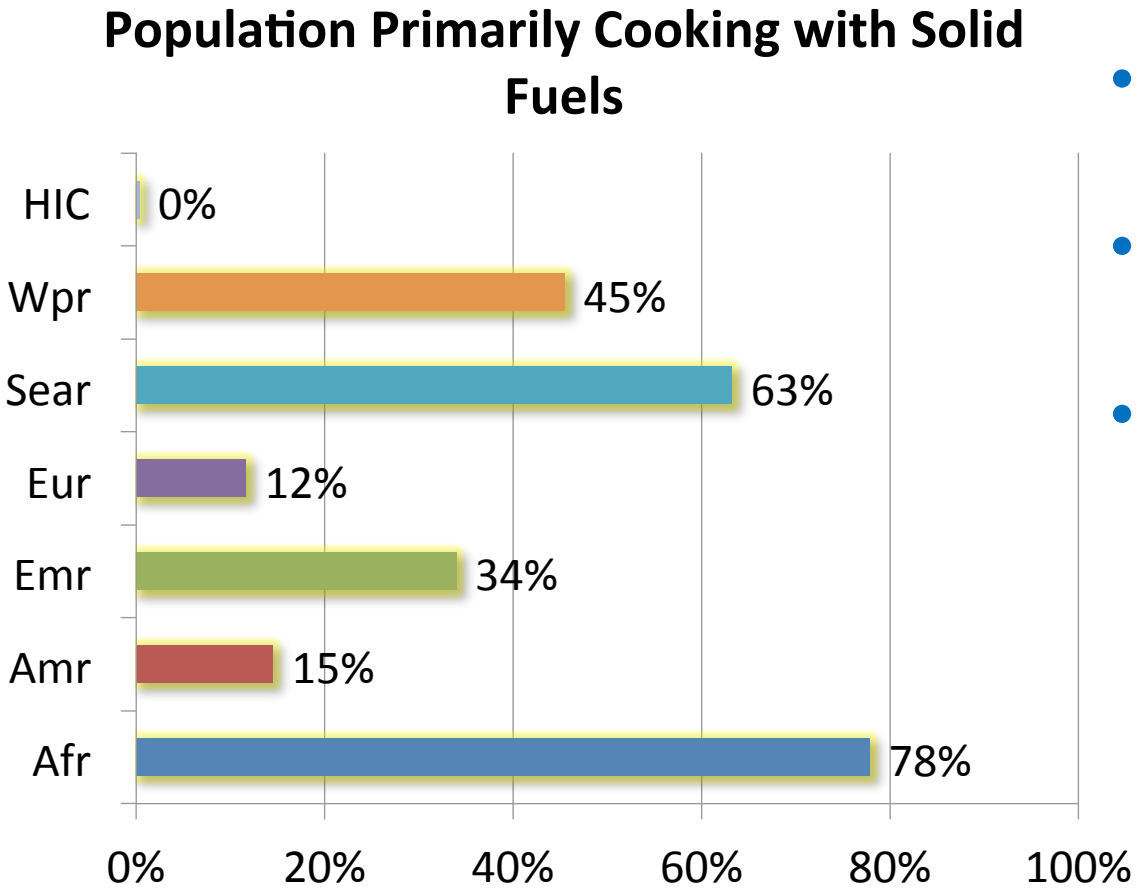
HAP Exposure, 2012



- 2.9 billion people exposed or…
- 42% of the global population
- % exposed has decreased, but the absolute # exposed has remained relatively constant

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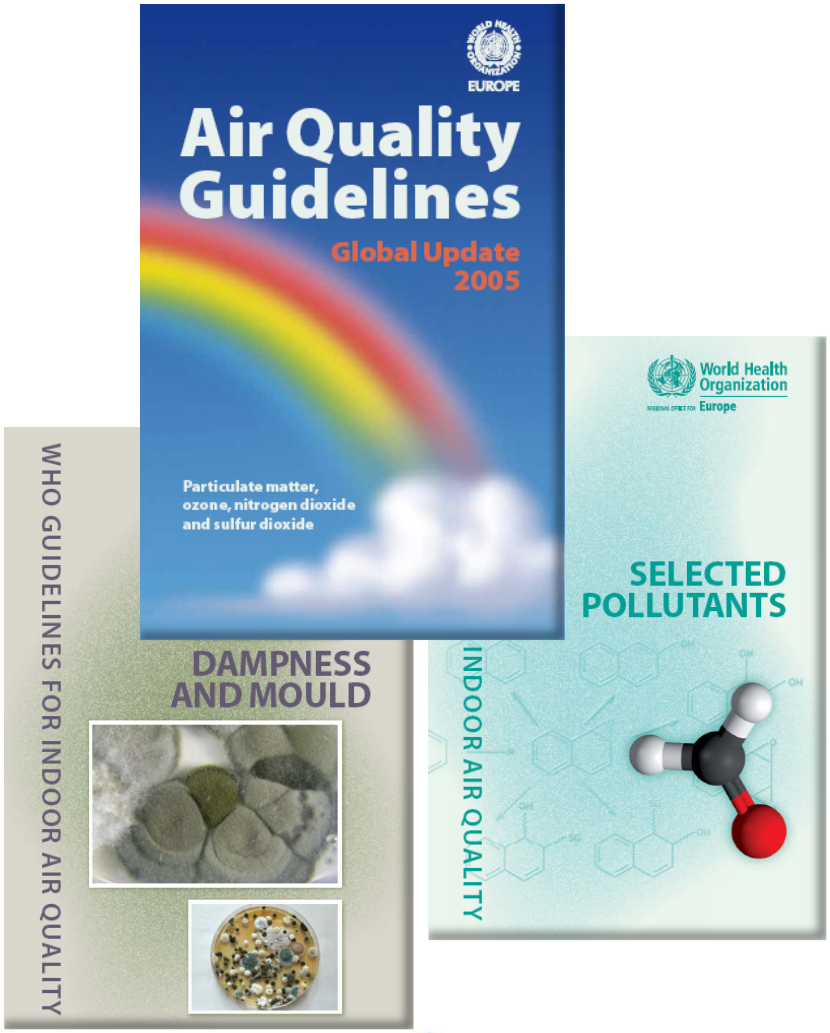
Existing WHO Air Quality Guidelines (AQG)

- Global update (ambient) 2005:
  - $PM_{2.5}$, PM_{10}
  - Chapter on IAP
- Indoor AQG:
  - Dampness and Mould: 2009
  - Selected pollutants: 2010
  - Household fuel combustion: this project



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WHO Air Quality Guidelines:
$PM_{2.5}$ and carbon monoxide (CO)

Pollutant	Guideline or target	Exposure period	Level ($\mu g/m^3$)
$PM_{2.5}$ (2005)	**Guideline**	**Annual average**	**10**
	IT-3		15
	IT-2		25
	IT-1		35
Pollutant	**Guideline or target**	**Exposure period**	**Level (mg/m^3)**
Carbon monoxide (2010)	Guideline	8-hour	10
	Guideline	24-hour	**7**

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New WHO IAQ Guidelines for household fuel combustion

Practical information on the performance and characteristics of domestic combustion technologies and fuels needed to prevent negative health effects attributed to air pollution caused by household fuel combustion.

To help develop, implement and evaluat policy to secure health benefits of household energy, with a primary (but not exclusive) focus on LMICs.

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Recommendations

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Focus of the recommendations:

1. What device and fuel emission rates are required to meet WHO air quality guideline for $PM_{2.5}$ (annual mean) and for CO (24 hour mean)?

2. In light of the acknowledged challenges in securing rapid adoption and sustained use of very low emission household energy devices and fuels, what approach should be taken during this transition?

3. Should coal be used as a household fuel?

4. Should kerosene be used as a household fuel?

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Extensive Evidence Reviews

- **Fuel use:** Global; for cooking, heating & lighting
- **Emissions:** range of technology & fuel options, how relate to AQG
- **Levels:** HAP and exposure
- **Health impacts of HAP:** risk for pneumonia, COPD, lung cancer, etc., including exposure-response.
- **Burns and poisoning:** risks, burden and interventions
- **Intervention impacts:** HAP/exposure in routine use
- **Adoption at scale:** barriers and enablers, costs/ benefits, finance

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Focus on emissions reductions – why?

- Outdoor ←→ indoor
- Evidence base stronger than for other approaches
- Implementation practicality – via design, production, standards, etc
- Some options (clean fuels), are relatively independent of user behaviour.

The need to test!

Kerosene heater

Flue-less gas

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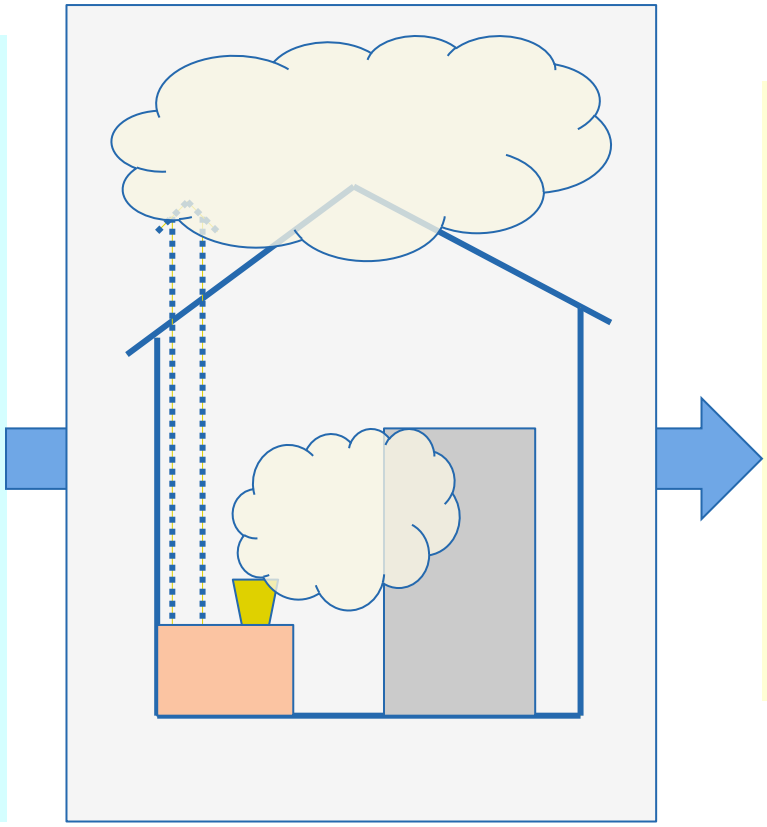
Model linking emissions to air quality

Inputs:

- Emission rates:
  - PM2.5
  - CO
- Kitchen volume
- Air exchange rate
- Duration of use (hours per day)



Outputs:

- Predicted average concentrations of:
  - PM2.5
  - CO

Assumes uniform mixing of pollutants and air in kitchen

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Rec. 1(a): Emission rate targets ($PM_{2.5}$)

Recommendation

For 90% of homes to meet the WHO AQGs for $PM_{2.5,}$ emission rates should not exceed the emission rate targets (ERTs) set out below.

Emissions rate targets (ERT)	Emission rate (mg/min)	Percentage of kitchens meeting AQG (10 µg/m³)	Percentage of kitchens meeting AQG IT-1 (35 µg/m³)
Unvented			
Final	0.23	90%	100%
Vented			
Final	0.80	90%	100%

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Rec. 1(b): Emission rate targets (CO)

Recommendation

For 90% of homes to meet the WHO AQG for CO, emission rates should not exceed the emission rate targets (ERTs) set out below.

Emissions rate targets (ERT)	Emission rate (g/min)	Percentage of kitchens meeting AQG (7 mg/m^3)
Unvented		
Final	0.16	90%
Vented		
Final	0.59	90%

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Recommendation 2: Policy during transition

Recommendation:

- Promote clean fuels where and when possible
- For many, it will take time to meet AQGs (especially $PM_{2.5}$), so intermediate steps (solid fuel stoves) may be required
- Solid fuels: test emissions (ref Recommendation #1), use best possible options
- Monitor use and air pollution (not just laboratory)

- **Rationale:**
  - Health evidence: need low levels for major health benefits (ALRI)
  - In practice, solid fuel stoves not achieving low levels (some vented wood stoves 35-70 $\mu g/m^3$)
  - Even clean fuel users well above IT-1 (other sources)
  - Based on evidence, requires (near) exclusive use of clean fuels to achieve AQG ($PM_{2.5}$).

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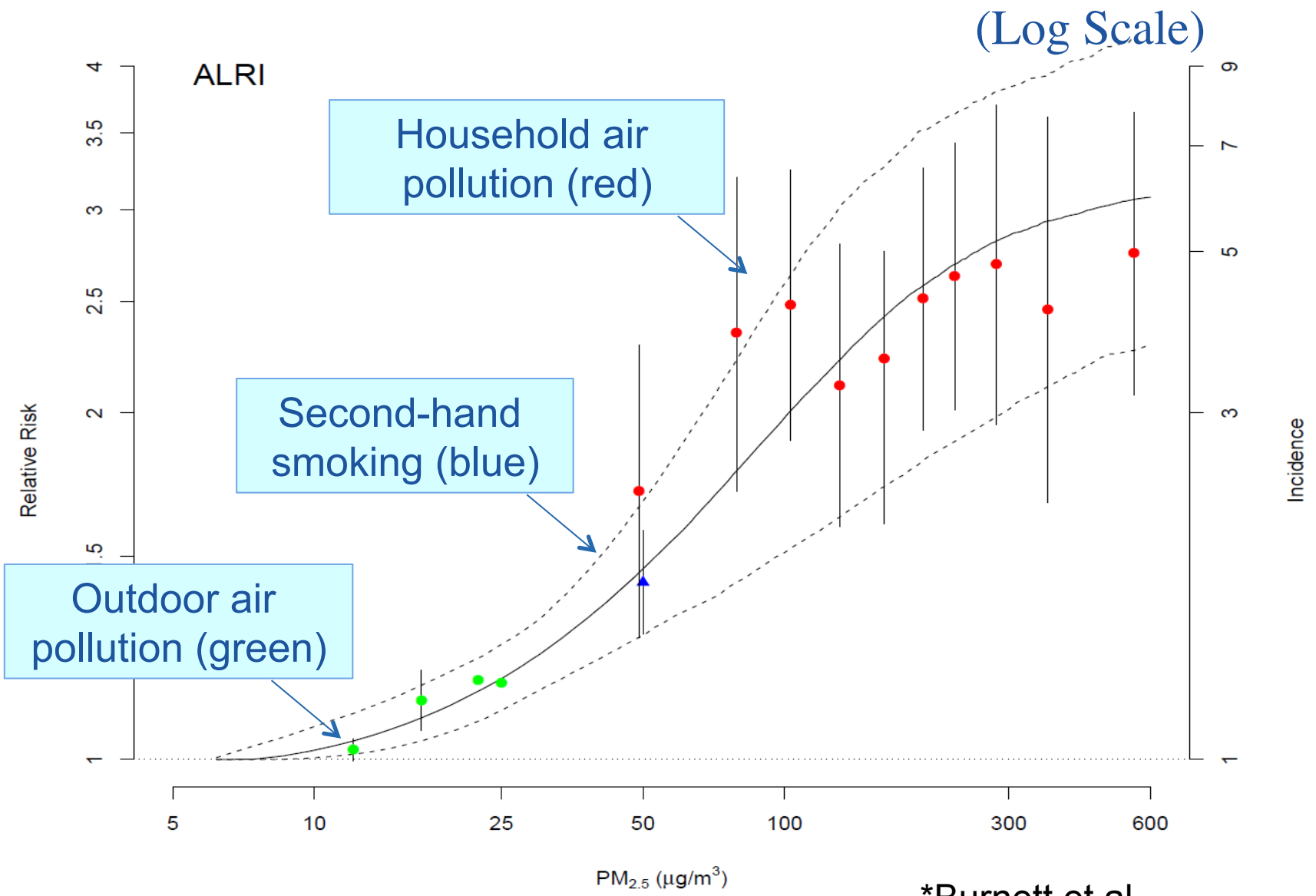
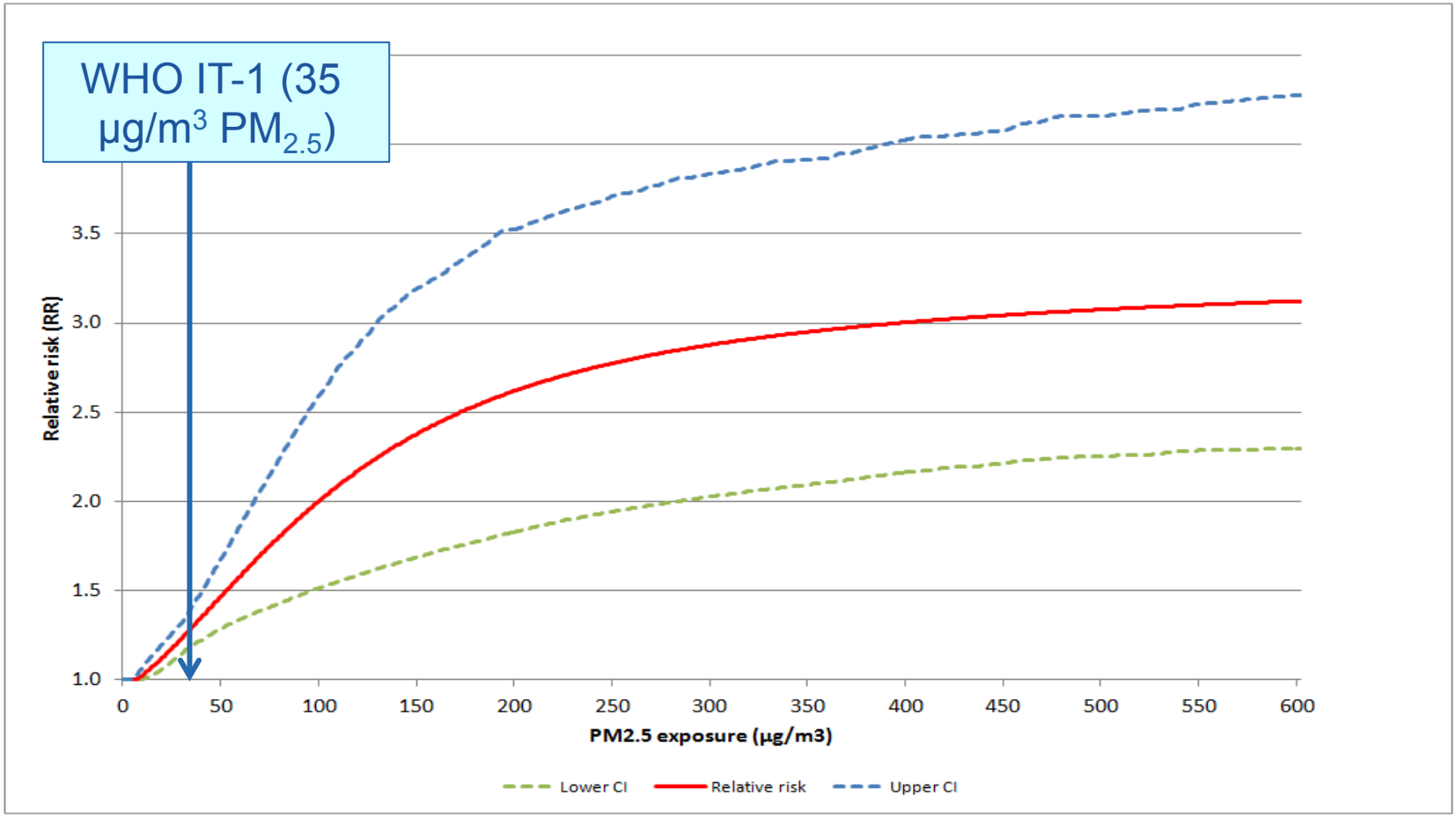
IER function*: $PM_{2.5}$ and child ALRI risk



*Burnett et al

IER function for $PM_{2.5}$ and child ALRI risk (linear scale)



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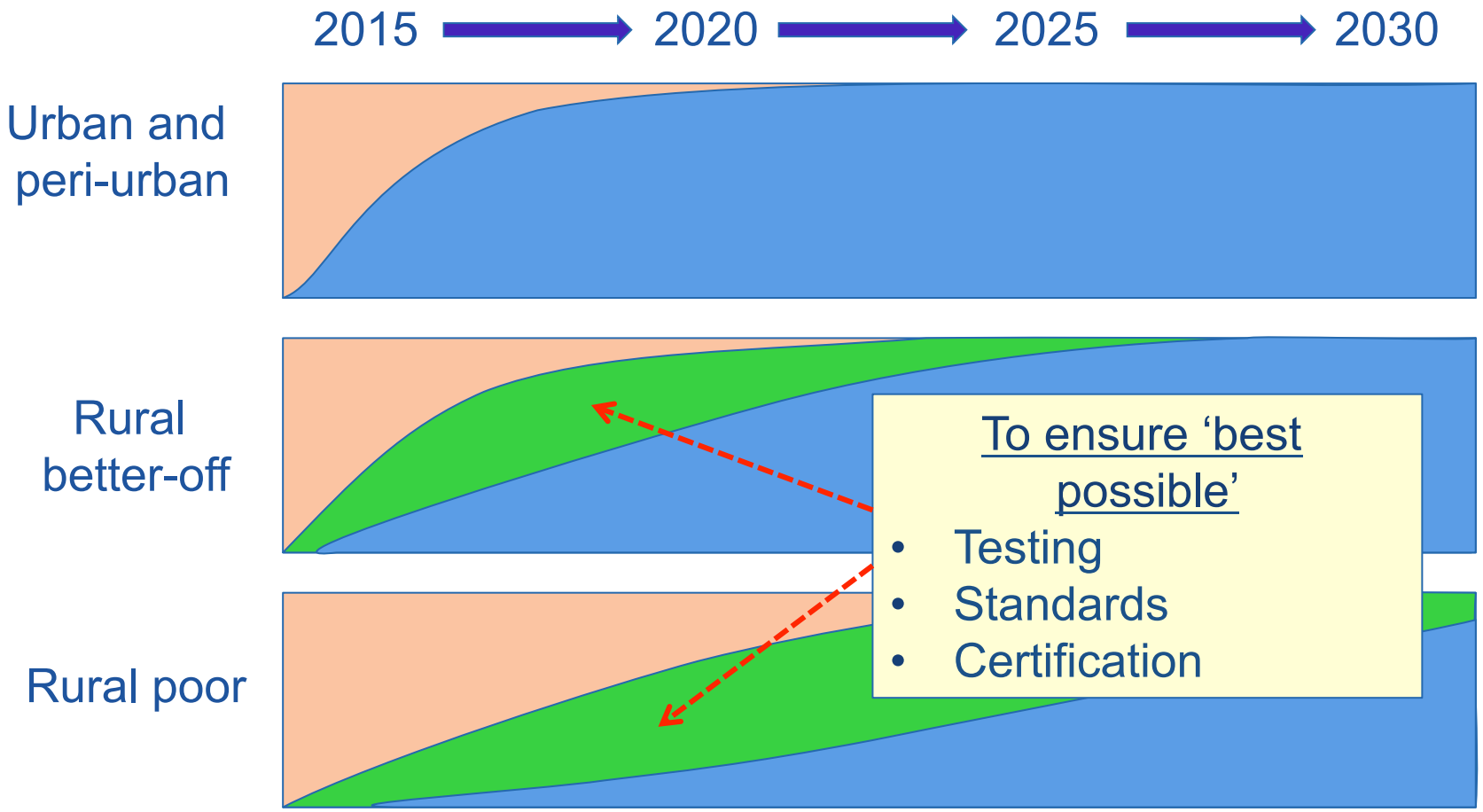
Rec 2: Household energy transition



Traditional biomass

Low emission biomass

Clean fuel

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Rec. 3: Household use of coal

Recommendation:
Unprocessed coal should not be used as a household fuel

- **Rationale:**
  - It is very difficult to burn coal cleanly in home
  - IARC Monograph: emissions from household use of coal are a Group 1 carcinogen
  - Coal often contains toxins (fluorine, arsenic, mercury, etc.) which are not destroyed on combustion.
- There should be further assessment of so-called 'clean' and 'smokeless' coal

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Rec. 4: Use of kerosene

Recommendation:
Household combustion of kerosene is discouraged while further research into its health impacts is conducted

- **Rationale:**
  - High levels of emissions of PM and other health-damaging emissions.
  - Epidemiologic studies suggest links to tuberculosis, cancer, respiratory disease, adverse birth outcomes, etc., but are not of adequate consistency/quality.
  - Kerosene use carries substantial risks of burns and poisoning.

(p. 53)

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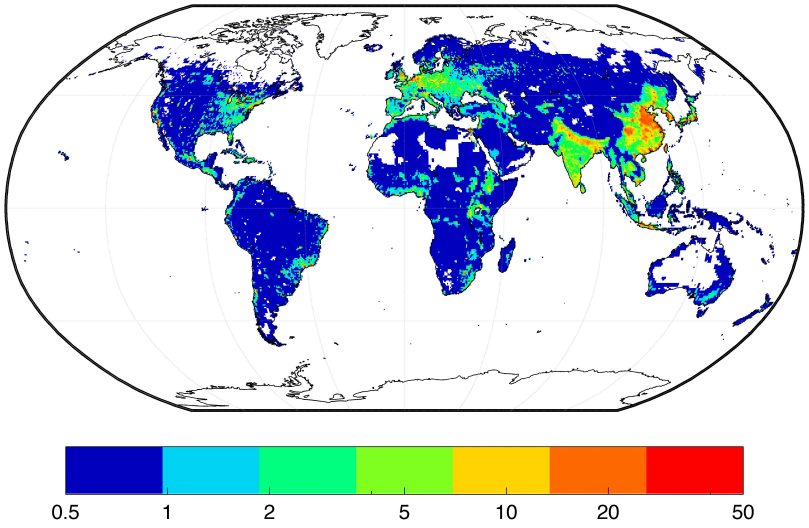
Good Practice Rec: Securing health and climate co-benefits

Recommendation:

Considering the opportunities for synergies between climate policies and health, including financing– governments and agencies who develop & implement policy on climate change mitigation should consider action on household energy and carry out relevant assessments to maximize health and climate gains.

p. (55)



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Additional issues addressed

1. **The home does not exist in isolation**:
   - Emissions from household combustion contribute outdoor air pollution, some of which re-enters homes
   - Outdoor air pollution from any source (including neighbours' houses) enters homes
2. **Safety risks**: Household fuel combustion devices/fuels linked to increased risks for burns, scalds, fires, and poisoning
3. Substantial challenges in achieving effective and **sustained adoption**.
4. Growing evidence on **synergies** between health and climate impacts

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Next Steps: Implementation

WHO will be working with countries to build capacity and support the implementation. Activities include:

Web-based guidance/tools, including:

- Country-based needs assessment
- Interactive versions of emissions model (allowing regionally derived inputs)
- Tool for assessing health impacts and costs of intervention options (IER functions) - HAPIT
- Tool for planning policy for effective adoption
- Methods for monitoring and evaluation

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Next Steps: Implementation

Monitoring & evaluation:

- **Enhanced** tracking fuel and technology use trends through the WHO Global Household Energy Database and air quality measurements in Global HAP measurement database

- **Extend** monitoring to include not only cooking fuels, but also data on lighting and heating information for more refined estimation of health burden.

- Working with national survey networks to **harmonize** data collection on household energy data collection to better estimate health impacts

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Next Steps: Implementation

Field research on health impacts to assess the effectiveness of interventions:

- Which technologies (including improved ventilation) work best, and are safe
- How behaviour changes may contribute to reducing levels of HAP or exposure
- Role of fuel/technology stacking and how to reach widespread and near-exclusive use of clean fuels/technologies

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Next Steps: Implementation

Standards, testing and regulation:

- **International standards (ISO)** for cookstoves and associated testing protocol are under development for cookstoves
- WHO acting as **Category-A Liaison Organization** within this ISO process
- Advising regions, countries and other partners on installing capacity to test and certify fuels and technologies
- Supporting governments to incorporate standards and testing protocols into policies and regulations

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Thank you!

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Extra Slides

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Integrated Exposure Response (IER) functions included

- Child ALRI
- Ischaemic heart disease
- Stroke
- Lung cancer
- Chronic obstructive lung disease

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Health risks from exposure to Household Air Pollution (HAP) from solid fuels

Strong evidence	Tentative evidence
• Child pneumonia • Low birth weight • Chronic obstructive pulmonary disease (COPD) • Lung cancer (coal) • Lung cancer (biomass) • Cataract • [Cardiovascular disease]	• Stillbirth • Pre-term birth • Stunting • Cognitive development • Asthma • Other cancers (naso-pharynx, uterine cervix) • Tuberculosis

Also: health risks (including safety) from kerosene and gas

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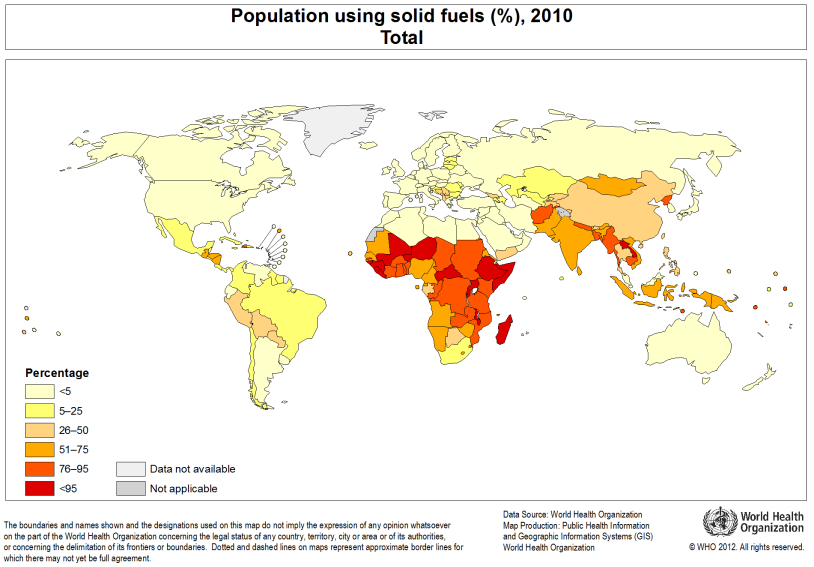
Household air pollution (HAP) disease burden

- **Exposure**:
  - Cooking: 2.8 billion primarily using solid fuels for cooking
  - Heating: less well quantified; HIC and LMIC
- **Disease burden:**
  - 4.3 million premature deaths in 2012, cooking alone
  - 0.4 million ambient air deaths due to HAP
- Most deaths in LMIC



http://www.who.int/gho/database/en/

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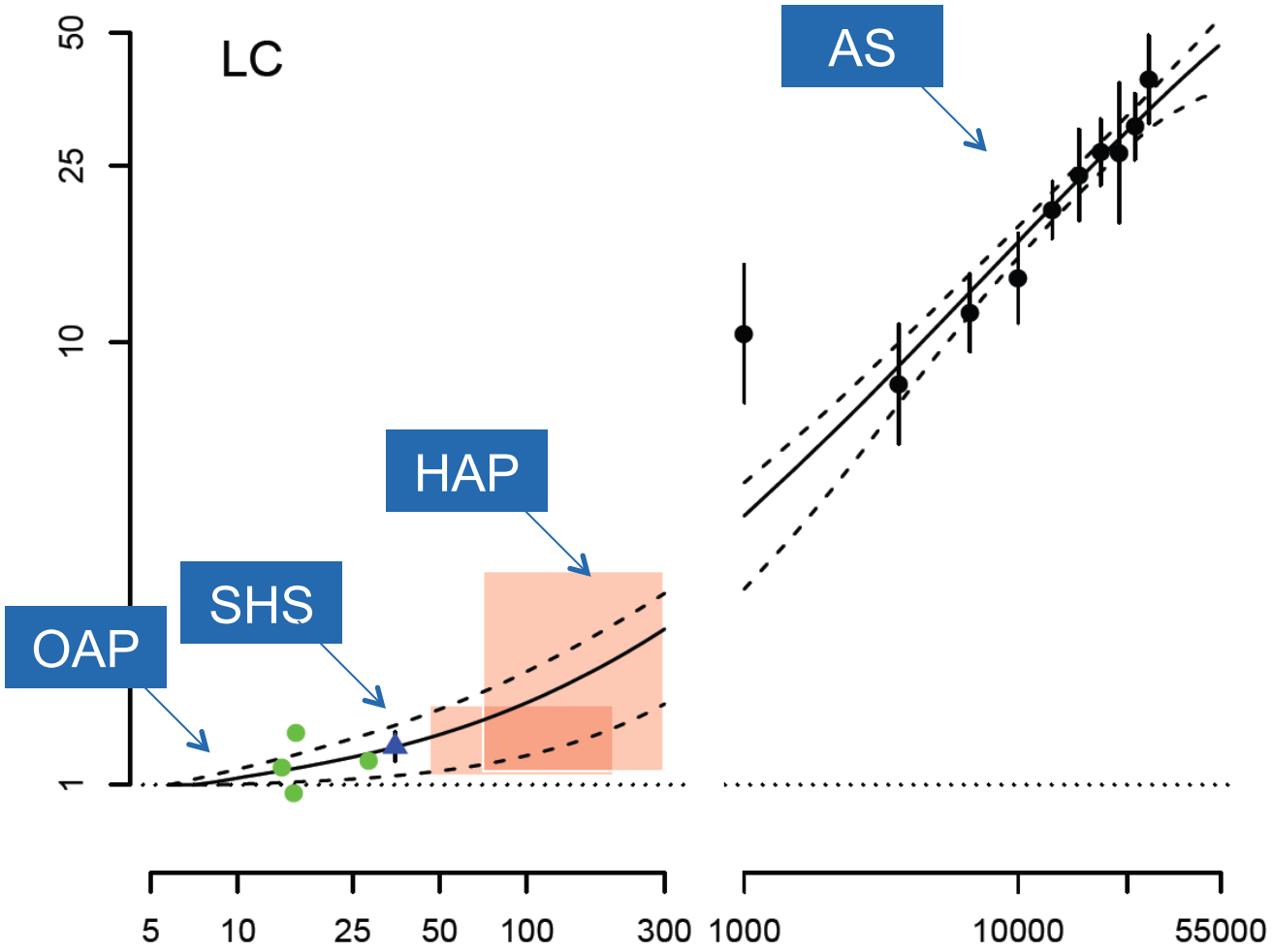
IER function: lung cancer



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General considerations

- Household emissions enter ambient air, re-enter homes and lower IAQ: hence, total emissions should be minimised.
- Local ambient air quality (from homes and other sources) affect indoor air quality: this must be considered in order to achieve clean indoor air.
- Homes have multiple energy needs (cooking, heating, lighting, etc.) so use and emissions from **all sources** should be considered.
- Household energy use carries risks of burns and poisoning. Safety of interventions should not be assumed: approaches to minimize exposure to emissions should be taken in a way that incorporates safety concerns.
- Interventions need to be available and affordable, or harms may result from energy poverty.

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Model inputs

Table R1.1: Input distributions for air exchange rates, kitchen volumes and device burn times used in the development of the ERTs

Parameter	Unit	Geometric mean	Range		SD[a]
			minimum	maximum	
Air exchange rate (α)	per hour	15	5	45	7.5
Kitchen volume (V)	m^3	30	5	100	15
Device burn time	hours per day	4	0.75	8	2

[a] Standard deviation

- Venting removes a proportion of pollutant to exterior
- Based on empirical data, the model assumes that the proportion emitted into the room is 25% (range 1-50%; SD=10

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